Envirothon Skull Reference Resource

Examining
Predator and Prey
Carnivore, Herbivore and Omnivore
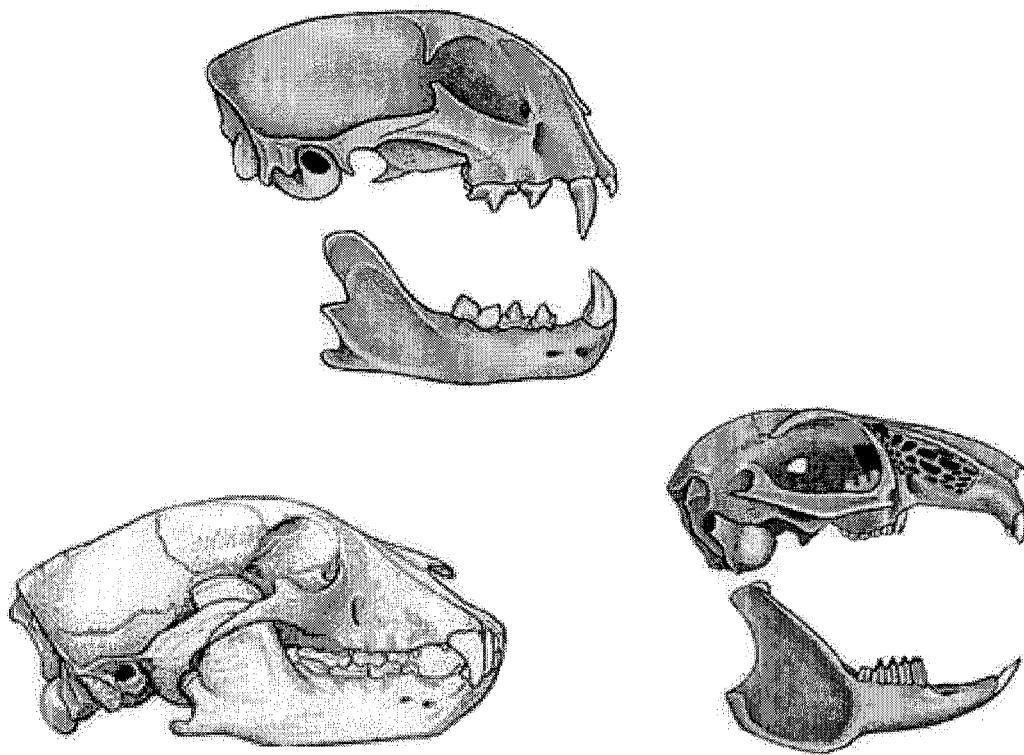
Predators and Prey

Carnivore, Herbivore, Omnivore

All animals require food, water, shelter and space to survive. Wild animals meet these needs in their habitats. Food requirements vary for different animals. Some animals tend to eat a wide variety of foods, while others may eat just one specific plant. Some animals tend to be eat meat while others tend to eat vegetation. Still other animals eat both vegetation and meat on a regular basis. Biologists divide animals into three general categories based on the types of food they eat namely, carnivores, herbivores and omnivores.

A *carnivore* is an animal that primarily eats meat. Food is obtained through predation and/or scavenging. (Examples are bobcats, otter, great blue heron, hawks and owls).

An *herbivore* is an animal that mainly eats vegetation and obtains food by foraging, browsing and grazing. (Examples are deer, elk, rabbits, cardinals and mallard ducks)

An *omnivore* is an animal that eats both vegetation and meat on a regular basis. (Examples are bears, raccoons and opossums.)

Categorizing animals by the type of food they eat can become even more specific, for example, animals, whose major food is insects, are referred to as insectivores. The short-tailed shrew and the little brown bat are examples of insectivores.

Predator/Prey Adaptations

Animals have physical and behavioral adaptations that help them find, obtain and eat the food they eat. Animals that capture and kill other animals for food are considered *predators*. Many carnivores and omnivores are predators because they obtain some or all of their food by actually capturing, killing and eating other animals. The animals the predator captures, kills and eat are referred to as *prey*. Prey species include most of the herbivores. However, carnivores and omnivores can be prey as well.

While there is a wide array of adaptations among species, there are adaptations that tend to be associated with predators and adaptations that tend to be associated with prey species.

Some adaptations associated with predators include: binocular vision, keen senses of hearing, sight and smell, sharp claws and teeth that are adapted for slicing and chewing meat and the ability to run, swim and/or fly very quickly -(usually) in short spurt. Birds of prey have curved sharp talons and hooked beaks to help them capture and feed on prey species.

Example: River otters and bobcats are both carnivores and predators, however they live in very different habitats and eat different foods. A river otter lives in rivers and streams and eats fish, crayfish and other animals. A bobcat lives in forested areas and eats mice, squirrels, shrews and other animals. Otters and bobcats have physical and behavioral characteristics to help them find, catch and eat other animals. Both have binocular vision with their eyes placed toward the front of their face. Binocular vision helps provide the accurate sight and depth perception needed for predators to see and catch their prey. They also both have sharp claws and bodies built for speed and agility.

Species that tend to be prey species typically have monocular vision, with eyes placed on the sides of their head. This helps give the animal a wide range of view to the side. Prey species also have behavioral and physical adaptations to aid in avoiding predators such as running and hopping in a zigzag fashion, "freezing", being camouflaged and/ or warning predators by being brightly colored and having a bad taste. Some prey species also have defense mechanisms, such as the spines on a porcupine or the smell of the skunk.

Skulls

Animal skulls can give a biologist clues to the diet of the animals and whether the animals tends to be predator or prey.   By examining the teeth of the animals and the placement of eye sockets, biologists can gain a better understanding of the role of the animal within the ecosystem.

Teeth
The teeth and arrangement of teeth in an animal's jaw is referred to as "dentition". Teeth are divided into 4 major groups: incisors, canines, bicuspids (or first premolar), molars. These different kinds of teeth perform different functions.

> *Incisors* are the front teeth with sharp, but rather flat, edges are good for cutting and snipping. They are used to gather food and snip off small pieces of foods such as nuts, bark, leaves, fruit and meat.

> *Canines* are the conical, pointy teeth found in the front of the mouth on either side of the incisors. Some species do not have canines or have canines that are small and ap-pear to me more like incisors. The more typical canines are pointy and sharp and are used for piercing, holding and tearing.

> *Pre-molars* are found on the sides of the jaw, next to the canines (if there are canines). They come in a variety of shapes and sizes but are usually smaller than the molars. Some premolars are adapted for crushing while others are good for slicing. Premolars also are considered deciduous. In other words, there is a milk set (when animal is young) replaced by an adult set.

> *Molars* are found in the back of the jaws and also vary in shape and size. Some molars are flat for grinding or serrated with sharper edges for cutting. Typically molars are fully developed only when an individual is an adult.

All species do not have the same number, types or arrangement of teeth. The presence or absence of various types of teeth and the number and the configuration of teeth can help identify a species as well as provide a clue to an animal's diet. Mammalogists have develop a shorthand to summarize the dentition of animals by listing the number and kinds of teeth in an animal on the upper and lower jaw of one side of a skull then multiplying by 2 to get the total number of teeth.   This is often referred to as the "tooth formula" for the species.

For example:

White-tailed Deer = $\underline{0} - \underline{0} - \underline{3} - \underline{3}$ x2 = Total teeth 32
             3 1 3 3

Key: Starting from the left, First column= incisor, Next column= Canine, then the Premolars and then the Molars.

      <u>Upper jaw </u>(one side of jaw only)
      Lower jaw (one side of jaw only

So, the white-tailed deer has
0 incisors in the upper jaw and 3 in the lower jaw on one side= 6 total incisors (both sides)
0 canines in upper jaw, 1 canine in lower jaw on one side= 2 total canines (both sides)
3 premolars in upper jaw, 3 premolars in lower jaw on one side=12 total premolars (both sides)
3 molars in upper jaw, 3 molars in lower jaw on one side= 12 total molars (both sides)

Total for both right and left side, upper and lower jaw = 32

Carnivores: Carnivores have small sharp, narrow *incisors*. They are typically much smaller than their other teeth and are good for cutting and piercing meat. The *canines* in carnivores are well-developed and prominent. Large and sharp, the canines in carnivores are usually longer than all of the other carnivore teeth and are good for holding, tearing and slashing. The pre-molars and molars of carnivores are typically very serrated, jagged and sharp. These teeth, located on the sides of the jaws, provide scissor-like cutting when the animal closes its teeth.   Biologists refer to the sharp, jagged molars and premolars of the carnivores as *carnassial* teeth.

Herbivores: Nearly all herbivores have *flat premolars* and *molars,* although the shape can vary drastically. In most herbivores, canines are extremely small or do not exist at all. The dentition of herbivores does vary with the types of food eaten and can generally be divided into 3 categories: rodents, ruminants and perissodactyles

     Rodents: A key feature of squirrels, voles, mice, beavers and other members of the rodent family are their large, well-developed *incisors* that continually grow continually throughout their lives. A pair of long, large, chisel-like incisors are found on their upper jaw, as well as their lower jaw, and are used to gnaw through vegetative material. The incisors are followed by a toothless gap called a *diastema.* Next come the *molars* (and in some cases, *premolars*) on the sides of the upper and lower jaw. The molars (and premolars, if they exist) typically have a corrugated surface and lean inwards. These are used to chew the vegetation they eat.

     Although not a rodent, the eastern cottontail also has incisors that grow throughout their lives. They have no canines. The upper jaw of the rabbit actually has 2 pairs of incisors, arranged with the larger rodent-like incisors a bit in front of smaller peg-like incisors. The lower jaw has one pair of incisors. These incisors help the rabbit gnaw vegetation. The incisors are followed by a diastema and then the premolars and molars.   The molars and premolars help in the chewing of the vegetation.

Tooth formula for Eastern Cottontail: $\underline{2} - \underline{0} - \underline{3} - \underline{3}$ Total teeth both sides= 28
                                  1   0   2   3

Ruminants: Ruminants are animals that have complex stomachs with three to four chambers. They eat a variety of high fibrous food, like grasses, twigs, etc. These animals "chew their cud"- meaning they can eat quickly, then later bring up food to ruminate or chew thoroughly at a later time. The teeth of ruminants have been adapted for snipping off vegetation, chewing and grinding. Some ruminants, like cows, deer and elk have incisors in the lower jaw but none in the upper jaw. The incisors are wide with sharp beveled edges. These animals tear vegetation using the lower incisors and a callous pad found on their upper gum. Then they grind the vegetation in the flat, well-formed molars and premolars. Most have elongated jaws with a toothless gap or diastema found between the premolars and incisors (and canines if present). Strong masseter muscles provide the power for crushing and grinding their high fibrous foods.

Most ruminants have no canines or, if they have canines, they are small. White-tailed deer have no canines in their upper jaw, but they do have small incisor-like canines in their lower jaw (see tooth formula for white-tailed deer) Elk have small incisor-like canines in their lower jaw but a bit larger canines in their upper jaw referred to as "ivories". However the canines of the musk deer of Asia are large and have developed into long tusks used in fighting.
Noet: The lower canines on elk and deer are located next to the incisors and look so much like incisors, that most people think they are incisors.

Perissodactyls or odd-toed ungulates, such as horses, have incisors in both their upper and lower jaws that help them bite off vegetation. They can have canines, for example many male horses have canines, although they are small. The premolars and molars are well formed and help grind vegetation. Most Perissodactyles also have rather elongated jaws with a diastema between the incisors (and canines if present) and the premolars.

Omnivores

Omnivores eat both plants and animals, so their teeth must be able to crush and grind plant material as well as cut and tear animal flesh. Omnivores come in all different shapes and sizes but all have well-developed incisors, canines, premolars and molars in both their upper and lower jaws. Incisors are edged for cutting but may be narrow or wide depending on the species. Canines also differ among species with some being long and specialized and other around the same length as the incisors. Premolar and molars may have some sharp edged to aid in tearing plant and animal materials, as well as, flat edges for grinding and crushing.

Eye sockets

Eye placement also varies among species. Many prey species have eyes place more on the sides of their heads. Therefore, in looking at the skull, the eye socket is placed more towards the side of the head. This placement allows for a wide range of view to the side and back and helps prey species, many of which are herbivores, have a wide areas in which to spot predators. Predators, however, usually have eyes that face forward. This helps predators have the depth perception and visual acuity needed to locate and catch their prey. So, typically, the placement of the eye sockets would be found facing front on a predator species.

Activity:

1. Pass out the background information about teeth and skulls to the students and allow time for them to read the material. Ask them to underline important details.

2. Explain to the students that they will be studying the skulls and teeth of various mammals. These mammals will include carnivores, herbivores and omnivores, as well as, predator and prey species.

3. Divide the students into groups. Provide each group with a copy of the attached skulls. Ask students to examine the skulls and classify them as to whether they are a carnivore, omnivore or herbivore based on the skull and teeth. Also ask them to determine if the animal is typically a predator or prey.

4. Next, have the students label the skulls with the correct names of the animals. Have students determine if they were correct in their guesses and correct their answers.

5. Ask students to label incisors, canines and premolars and molars (approximately). Also, if a diastema exists, have them label the diastema.

6. Ask students to discuss the following in reference to skull drawings:

   What features indicated a species would more likely be a predator species.

   What features indicated a species would more likely be a prey species.

   How can you differentiate between a carnivore, herbivore and omnivore?

Extension: Have students go on-line to view more skulls or obtain actual skulls and examine the structure and teeth.

For further references:

 Go to the Animal Diversity web page of university of Michigan at http://animaldiversity.ummz. umich.edu click on special topics then mammals or rotating skulls or all about teeth.

The Smithsonian Institute Zoology, North American Mammals website http://web4.si.edu/mna/ and search by species name.

Books
The Peterson Guide to Mammals
Mammals of Pennsylvania by Joseph F. Merritt
Skulls and Bones by Glenn Searfoss

A White-tailed deer

Order: Artiodactyla
Family: Cervidae
Odocoileus virginianus

Herbivore, note incisors in front of lower jaw and grinding premolars and molars in rear. The outer tooth that looks like an incisor is actually a small canine.
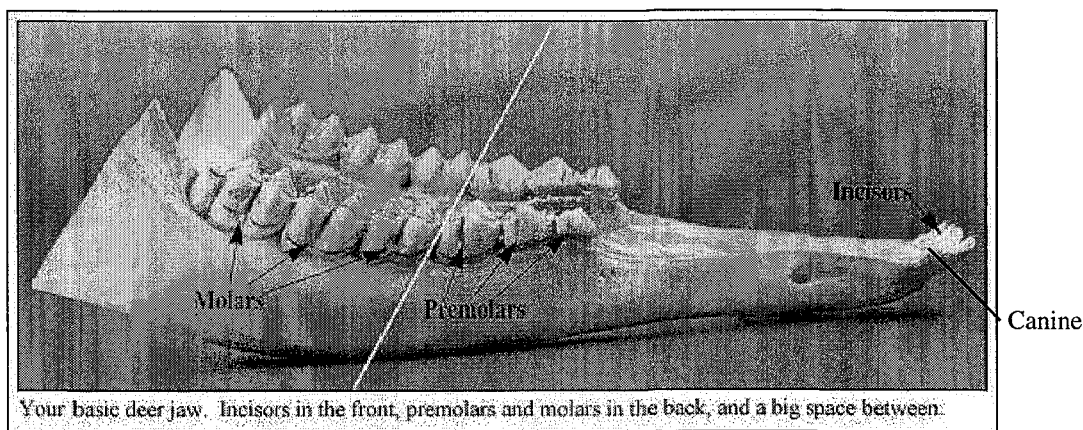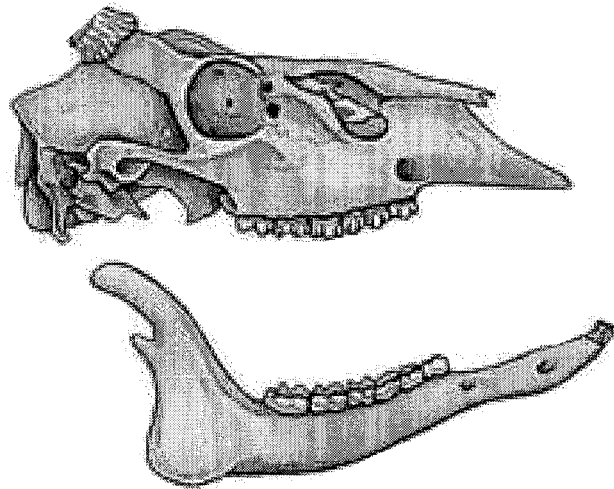
Prey species skull configuration, note eye socket on side of skull.

Tooth Formula

I   C   P   M

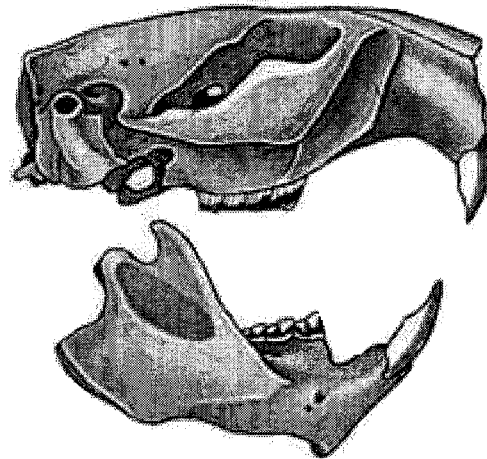$\underline{0 - 0 - 3 - 3}$ per side Total = 32 teeth
3 – 1 – 3 – 3

Your basic deer jaw. Incisors in the front, premolars and molars in the back, and a big space between.

B

American beaver

Order: Rodentia
Family: Castoridae
Castor canadensis

Herbivore and member of the rodent family.
Note the large incisors in the front.
Eye socket tends to be on the side of skull in a
more "prey-like" position.

I   C   P   M
1 – 0 – 1 – 3   per side   Total = 20
1 – 0 – 1 – 3

C

American Black Bear

Order: Carnivora
Family: Ursidae
Ursus americanus
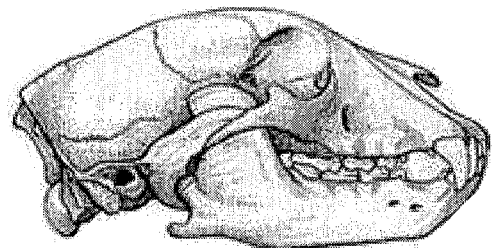
Although classified in the Order Carnivora, the
black bear is in actuality an omnivore.
Eye socket placement more forward like that of a carnivore. Teeth
configuration that has the sharp canines of a carnivore. The premolars and molars
can grind similar to those of an herbivore and cut similar to those of
carnivores.

Tooth Formula
I   C   P   M
3 – 1 – 4 – 2   per side   Total = 42 teeth
3 – 1 – 4 – 3

D Bobcat

Order: Carnivora
Family: Felidae
Lynx rufus some books list bobcat as Felis rufus

Carnivore, note the sharp canine teeth and the
small number of sharp molars and premolars called
carnassails.
Predator, note the eye socket placement towards front, as well as
the teeth typical of a carnivore.
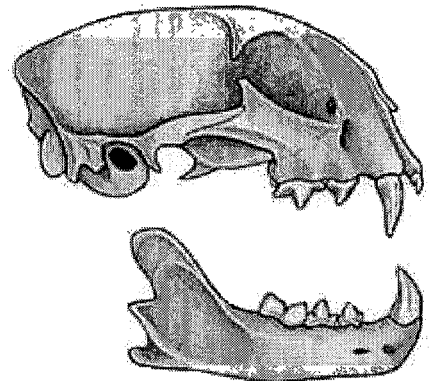
Tooth Formula
I   C   P   M
3 – 1 – 2 – 1   per side   Total = 28 teeth
3 – 1 – 2 – 1

E Coyote

Order: Carnivora
Family: Canidae
Canis latrans
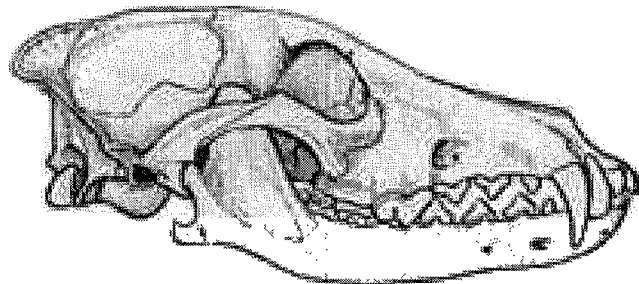
Although in the Order Carnivora, the coyote is an omnivore.
The Eye placement reflects the often predator role of a coyote.
Teeth show signs of both carnivore and herbivore with the large canines of the carnivore, the sharp premolars of a carnivore and molars that can both grind like an herbivore and cut similar to a carnivore.

Tooth Formula
I   C   P   M
3 – 1 – 4 – 2   per side   Total = 42 teeth
3 – 1 – 4 – 3

F   Eastern cottontail

Order: Lagomorpha
Family: Leporidae
Sylvilagus floridanus

Herbivore, note the large incisors.
Prey species, note eye socket
placement on side of skull.

Tooth Formula
I   C   P   M
2 – 0 – 3 – 3   per side   Total = 28 teeth
1 – 0 – 2 – 3
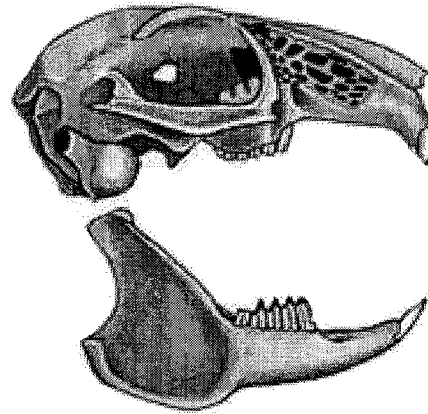
G   Northern raccoon

Order: Carnivora
Family: Procyonidae
Procyon lotor

Although in the Order Carnivora, the raccoon is an omnivore.
Eye placement reflects the predator role (at times) of a raccoon.
Teeth show signs of both carnivore and herbivore with the large canines of the
carnivore and molars that can both grind like an herbivore and cut similar to a
carnivore.

Tooth Formula
I   C   P   M
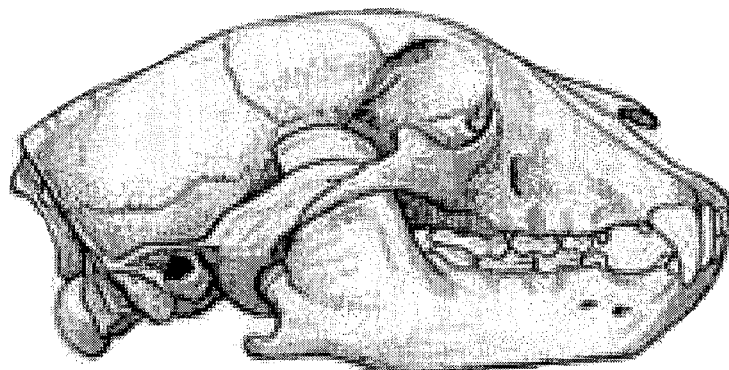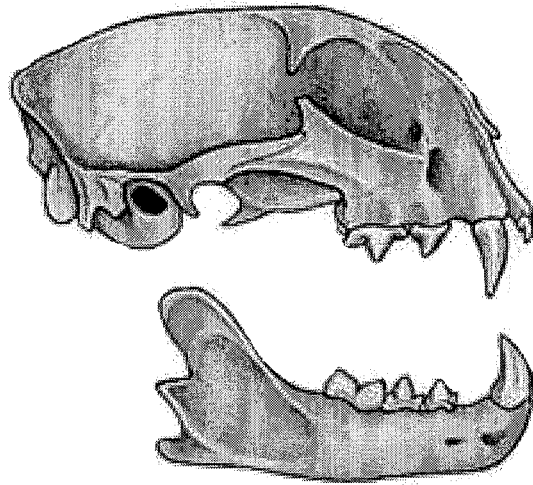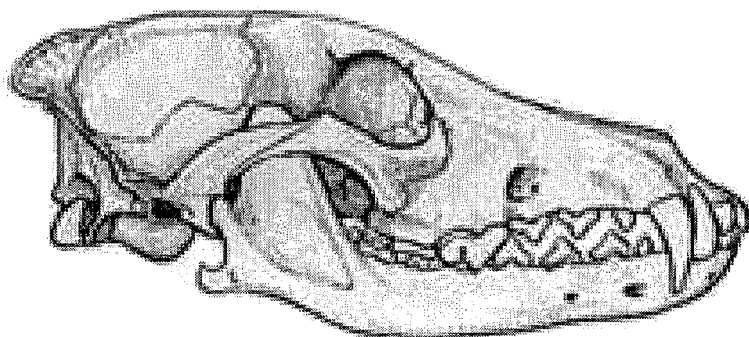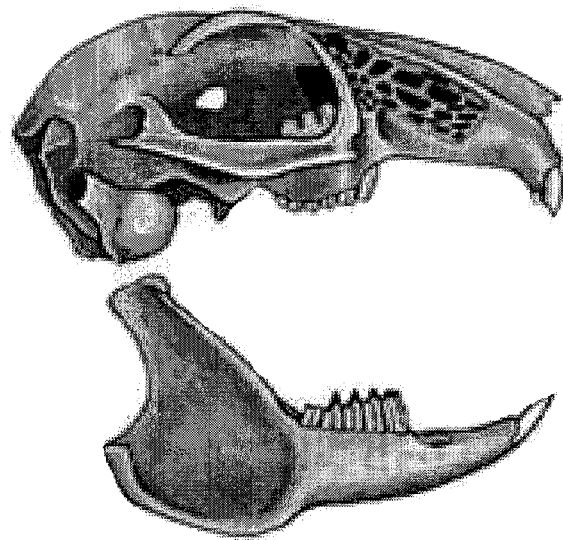3 – 1 – 4 – 2   per side   Total = 40 teeth
3 – 1 – 4 – 2
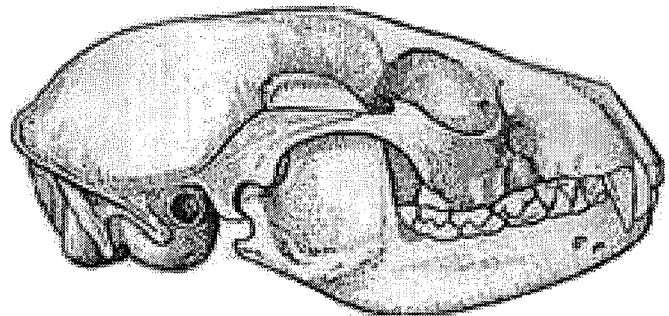
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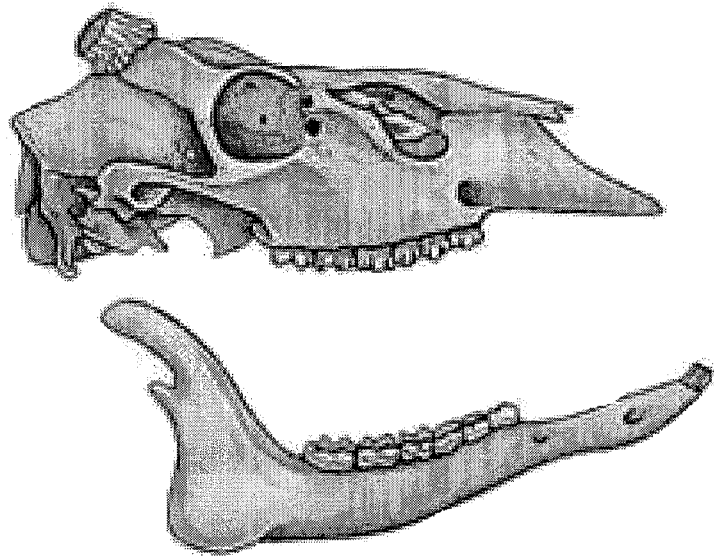
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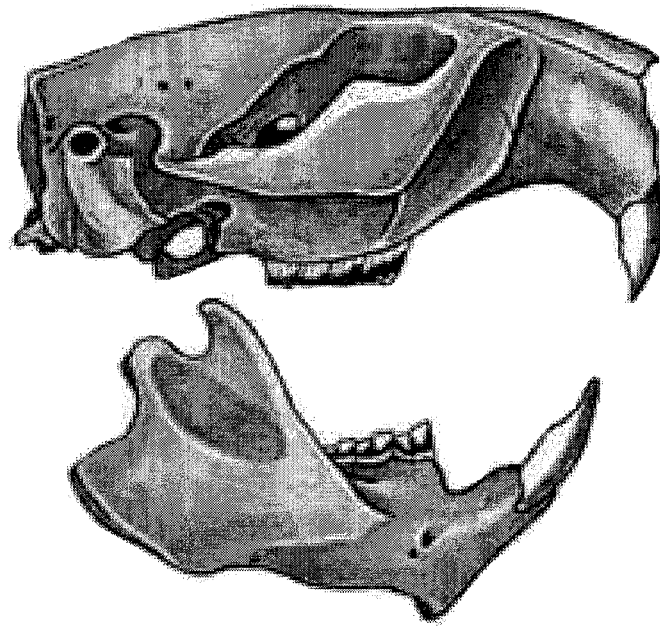
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C

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